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Book Review

G.P. Gladyshev, *Thermodynamic Theory of the Evolution of Life Forms*
(Moscow, Luch, 1996, 86 pages – in Russian)

Professor Georgy P. Gladyshev's book is an epoch making event in the natural sciences. The book is published by the Institute of Ecological and Biophysical Chemistry of the Academy of Creative Endeavor, and the Institute of Chemical Physics of the Russian Academy of Sciences. It is a wonder that such a book can appear in a country where the decline of science seems to be approaching its nadir. However, in spite of this decline, 1,000 copies of the book were printed. Even so the book's publication may pass unnoticed, so the reviewer considers it his duty to inform scientists working in biological and physical chemistry of this extraordinary publication event. The first publications of Professor Gladyshev addressing the development of a thermodynamic theory of evolution began to appear about 20 years ago in both Western and Russian journals (cf., e.g., *J. Theoret. Biol.* **75**, 1978, 425–444). These publications describe a thermodynamic model of biological evolution based on macrophysical and a hierarchy of thermodynamic rules and principles. This development draws the conclusion that the evolution of life forms can be explained without implementing the concepts of dynamic self-organization or dissipative structures. In contrast, the author formulates a rigorous thermodynamic approach to evolution based on supramolecular structures and the ontogenesis of the chemical composition of life forms during the great formative periods of general biological evolution, citing J.W. Gibbs: "... one of the principal objects of theoretical research in any department of knowledge is to find the point of view from which the subject appears in its greatest simplicity" (1881). The book presents the evidence for the author's concept that the origin and evolution of life is none other than the origin and evolution of thermodynamic self-organized (self-assembled) polyhierarchic systems. Neglecting the influence of the Almighty God, the author's approach is based only on Gibbs' thermodynamic principles.

By now it is well known that Darwin's theory cannot explain many observations and preserves its interest only for historians of science. Because of this circumstance, new approaches to biological evolution should find an attentive audience and without discussing the origins of the thermodynamic principles applied. (Is the originator the Almighty God or His creature Gibbs?) The book consists of

two chapters. The first treats the conventional view of how life forms evolve, but introduces Gibbs' thermodynamics in the treatment of a few systems. However, the major interest is in system changes, not the thermodynamics of the processes. The author analyzes the main points which a physical theory of evolution should be able to explain and proceeds to propose a model which can do so. The author's thesis is that under the action of the sun's energy, substances which are thermodynamically stable in the early conditions of the earth are transformed into various products of photosynthesis, those transforms being regulated by thermodynamic principles. During this process, from the resulting products only those stable suprastructures are selected which correspond to minimum states of the free energy of a biosystem. These structures are formed into micro- and macrovolumes of the system.

The second chapter treats in detail the interrelation between thermodynamics and the evolution of biological systems. The author describes a macrothermodynamic model, under development since 1967, which is based on the appearance of a hierarchy of structures formed as the result of the self-assembly of structures lower in the hierarchy. The applicability of the model to real systems (e.g., various organic substances) is analyzed and discussed using everyday examples. The model's predictions are compared with experimental data and a good fit is demonstrated. Among other topics within the theory's purview, are: the development of cancer cells, the development of human life forms from conception to death and methods for prolonging life. All of these topics are described with thermodynamic quantitative results. The author emphasizes that thermodynamics is the driving force for any evolution in nature, and therefore the model has general applicability. In an appendix, the differential equation forms of the macrothermodynamics of systems are provided, as well as definitions pertinent to the author's model. The major point of the book is that thermodynamics permits a description of the degree of self-organization of any system in the course of its evolution. The complexity of the system plays no role in establishing the direction of evolution of biosystems at the chemical and supramolecular level. Thermodynamic principles are operating within any local volume of supramolecular structures, as well as the macrovolume of the biomass.

The Gladyshev monograph is short in length (86 pages), which should be the case with any outstanding discovery – in the reviewer's opinion. This reviewer feels that the book should enjoy a level of esteem in world scientific opinion equal to that enjoyed by the work of I. Prigogine, K. Denbigh and others. In summary, the approach to evolution proposed by Gladyshev is a new, outstanding and important theoretical model, which should have a major impact on the way people think about evolution. (However, the author is astute enough not to treat the origins of humans, probably due to the many unsuccessful attempts to do so).

It is a great pity that the monograph in its present form is unavailable to all interested in evolution due the language of publication. Translating and

publishing the book into English would provide the world scientific community with the opportunity to learn about the greatest progress made in treating the evolution problem.

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